Volume II.] *October, 1900.* [*No. 1.*

BIOLOGICAL BULLETIN.

A STUDY OF SOME TEXAN PONERINAE.[1]

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THE observations hitherto published on the habits of the Ponerine subfamily of ants are extremely meager. This gap in our knowledge of ant life must be the more keenly felt by all myrmecologists because the Ponerinae (including the Cerapachyi, a group allied to the Dorylinae, or driver ants) are, to all appearances at least, the most generalized of existing Formicidae. That the Ponerinae have a very primitive morphological and social organization seems to be indicated by the facts, first, that their colonies are composed of a relatively small number of individuals — like the incipient colonies of the more specialized Myrmicine and Formicine ants, and, second, that the polymorphism of the female is still, apparently, in an unstable condition, *i.e.*, the workers often differ little if any from the queens, or females, in form and size, and the two phases are frequently connected by individuals of an intermediate character (ergatoid, or ergatomorphic females). It has also been suspected by Professor Forel and Professor Emery that the breeding habits of the Ponerinae would be found to be of a primitive nature.

The common occurrence of three beautiful species of Ponerinae in the environs of Austin, Texas, has induced me to undertake the following study of their habits. The ants were observed in a state of nature or kept in jars of earth or in

[1] *Contributions from the Zoölogical Laboratory of the University of Texas.* Director, W. M. Wheeler. No. 6.

artificial nests of the Lubbock and of the Janet pattern. In collecting material for these nests, I have been considerably aided by two of my students, Mr. A. L. Melander and Mr. C. T. Brues. Mr. Brues also aided me in drawing some of the figures that accompany this paper.

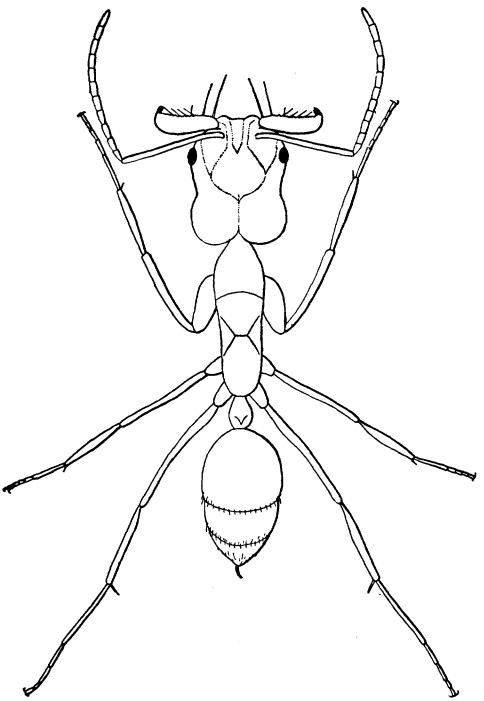

FIG. 1. — *Odontomachus haematodes* Linn. Worker.

The three species of Ponerinae which I have studied are: *Odontomachus haematodes* L.; *Pachycondyla harpax* Fabr. (= *Ponera amplinoda* Buckley); and *Leptogenys elongata* Buckley.[1] To European myrmecologists both *O. haematodes* and *P. harpax* are well-known species. They have a wide geographical distribution, occurring from Texas through Mexico, Central America and Brazil to Bolivia and Paraguay. *O. haematodes* is also recorded from Georgia, Florida, and the Antilles.[2] In the vicinity of Austin, *P. harpax* and *L. elongata* are found under

[1] Specimens of the last species were kindly identified for me by Mr. Pergande as *Lobopelta elongata* Buck.? The query seems to be due to Buckley's wretched description of his *Ponera elongata*. Since Lobopelta is treated as a subgenus of Leptogenys by Forel, and since the species is very common in Texas, and therefore, in all probability, the one described by Buckley, I have changed the generic name and omitted the query. Should doubts arise, my figures (Fig. 4) will, I trust, enable any future observer to recognize the species.

[2] See Emery, "Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna," *Zool. Jahrb.*, Abth. f. Systematik., Bd. viii, pp. 268, 269; Patton, *Amer. Nat.*, July, 1894, pp. 618, 619; Forel, Biologia Centrali-Americana, Hymenoptera, vol. iii, April, 1899, p. 21.

stones or logs, on moderately dry hill-slopes, often in the shade of trees or bushes, more rarely in the open fields. In these same localities *O. haematodes* does not occur. The few nests which I have seen belonging to this species were under stones lying on a dry sandy loam in a different part of Travis County. The exact distribution of these forms must be left for future determination.

It is not an easy matter to ascertain the exact number of individuals in any colony of the three species of Ponerinae. When the stone or log that serves as a roof to the nest is lifted, some of the ants always manage to escape, either into the surrounding vegetation or into their burrows. This is especially true of *L. elongata* and *P. harpax*, both of which, when excited, are very rapid in their movements. As a rough estimate it may be said that the nests of *L. elongata* contain from 10 to 50, those of *P. harpax* from 15 to 100, of *O. haematodes* from 100 to 200 individuals.[1]

The nests of the three Ponerinae agree in being of a very primitive structure. They consist of a few simple and irregular burrows, or galleries, some of which run along the surface of the soil immediately beneath the stone or log, while others extend down into the soil obliquely or vertically to a depth of 8 or 10 inches. These burrows may anastomose, but they are not widened at certain points to form chambers, as in the nests of the more specialized ants (Atta, Pogonomyrmex, Camponotus, etc.). Even in artificial nests of the Lubbock pattern the Ponerinae dig only anastomosing galleries scarcely more than a centimeter in diameter.

Owing to the interest which attaches to the sexual phases of the Ponerinae, considerable effort was made to secure both the winged and apterous forms of the Texan species. Of *O. haematodes* only workers were seen, but as the full series of phases of this species — including the winged male, winged female, and the apterous ergatoid female, as well as the worker

[1] In tropical America (*teste* Forel, *loc. cit.*, *passim*) *P. harpax*, race *Montezumia*, Smith, *O. haematodes*, and the species of Leptogenys make their nests also in rotten wood, and the first species is said to nest also in dry, hollow stems. The colonies of *O. haematodes* are probably more numerous in individuals in the tropics than at Austin.

—have been made known through the labors of European myrmecologists, I fixed my attention on the other species. I append a brief description of these species before recording their habits.

P. harpax (Figs. 2 and 3) is a large, rather robust, subopaque, black ant, which carries its body close to the ground. It has a peculiar habit of folding its antennae and of peeping out of holes and crevices in the soil like a rat. In nearly all the nests

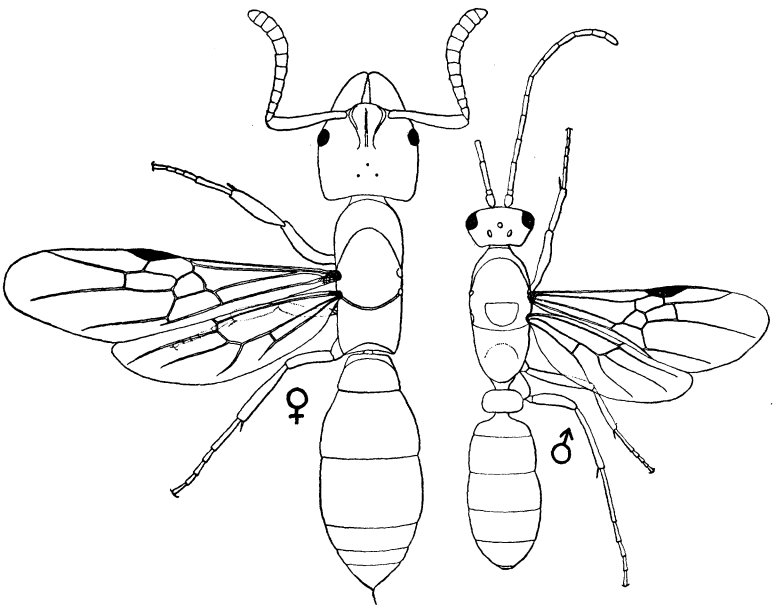

FIG. 2. — *Pachycondyla harpax* Fabr. Winged male and female.

that were opened only wingless individuals like the one represented in Fig. 3 were found. Except for a slight variation in size they were all alike externally, and I at first regarded them all as workers; but on dissecting several of these ants during the breeding season (from the 1st of March to the end of May) some of them were found to contain mature ova, while others had abortive ovaries. In a nest consisting of twenty-nine individuals captured May 27, dissection revealed the presence of mature eggs in thirteen, and one-third to one-half grown eggs in four of the ants. The ants were also caring for several

packets of eggs which they had laid. Like the pigeons among birds, *P. harpax* lays only two eggs at a time. I infer this from the fact that only two eggs are found to be mature in the ovaries. Since, in addition to these facts, wingless individuals actually laid eggs in my artificial nests, I feel certain that forms

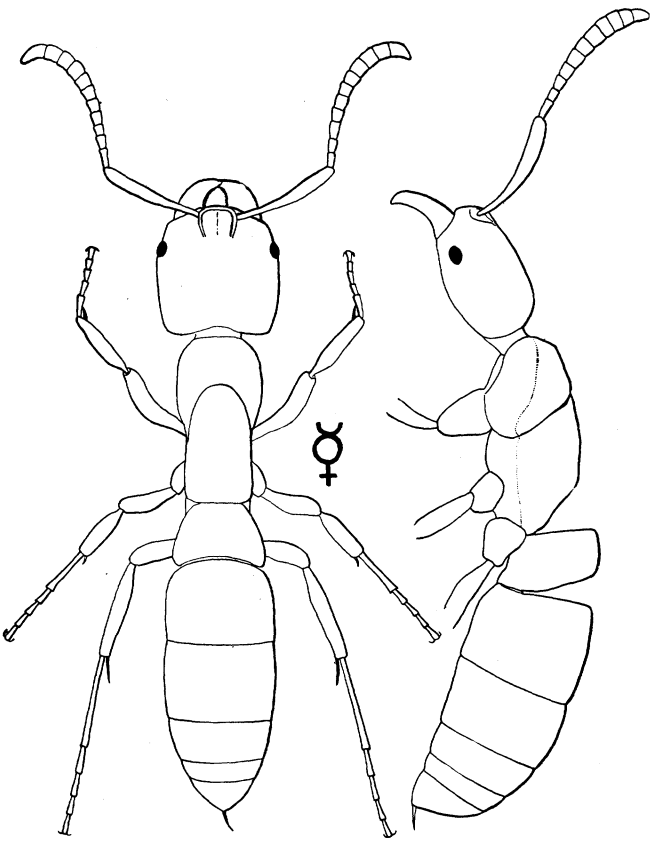

FIG. 3. — *Pachycondyla harpax* Fabr. Worker, dorsal and lateral aspect.

externally indistinguishable from the workers commonly function as females. These are, therefore, ergatoid or ergatomorphic females. There is not even a slight difference in size to separate the two forms externally, since some of the ergatoid females are smaller than some of the workers. There are, however, in certain nests of *P. harpax* winged females of a less

worker-like aspect. These were seen only twice — once in a large nest found under a log on March 12, and again in a nest discovered in a very different locality by Mr. Brues, March 31. In both nests there were many of these winged females resembling Fig. 2, ♀. They had small but distinct ocelli. Several of them had lost some of their wings, while a slight touch caused others to lose these appendages. Before finding these winged females, I had found the winged males as early as March 3 in a small nest containing ergatoid females and workers. There were two of these males clinging to the under surface of the stone that covered the surface galleries of the nest. They differ so much from the apterous females and workers, that, if taken on the wing, they would scarcely be regarded as ants (*cf.* Fig. 2, ♂, and Fig. 3). They are much shorter and more slender than the workers, and their long, slender, 13-jointed antennae are not geniculate, but straight, with the basal and second joints short and the remaining joints slender and subequal. The eyes and ocelli are very large and prominent. These and other equally pronounced structural peculiarities in the thorax and abdomen are shown in Fig. 2, ♂. The small mouth-parts, the hypopygium, trochanters, tibiae, and tarsi are honey-yellow; the venter and sides of the abdomen are piceous.[1] On the 31st of March I found four nests containing winged males. Three of these nests each contained three males, the remaining nest contained only two.

L. elongata is smaller and far more slender than *P. harpax*, with long delicate legs and antennae. The specific name is very applicable not only to the adult ant but also to the egg, larva, and pupa. The worker (Fig. 4, ☿) is of a rich claret red color, becoming yellow towards the tip of the abdomen. In form, color, and movement this ant is certainly the embodiment of elegance. The workers which were dissected — some thirty specimens from different nests — contained only minute and abortive ova, and for some time I failed to find the queen.

[1] To my knowledge no description has hitherto been published of the male of the typical *P. harpax*. I infer, however, from Forel's contribution (*loc. cit.*, p. 12) that Smith has described (*Cat. Hym.*, vol. vi, p. 108, 1858) the winged male of his *P. montezumia*, a form which Forel regards as merely a Mexican race of *P. harpax*.

Finally I noticed in each nest a single ant with a somewhat larger abdomen than that of the workers, but, like them, without any traces of wings. Dissection of three such individuals disclosed mature eggs — only a single pair in each insect, as in Pachycondyla. There could be no doubt that I had found the hitherto unknown female of Leptogenys.[1] They have no ocelli,

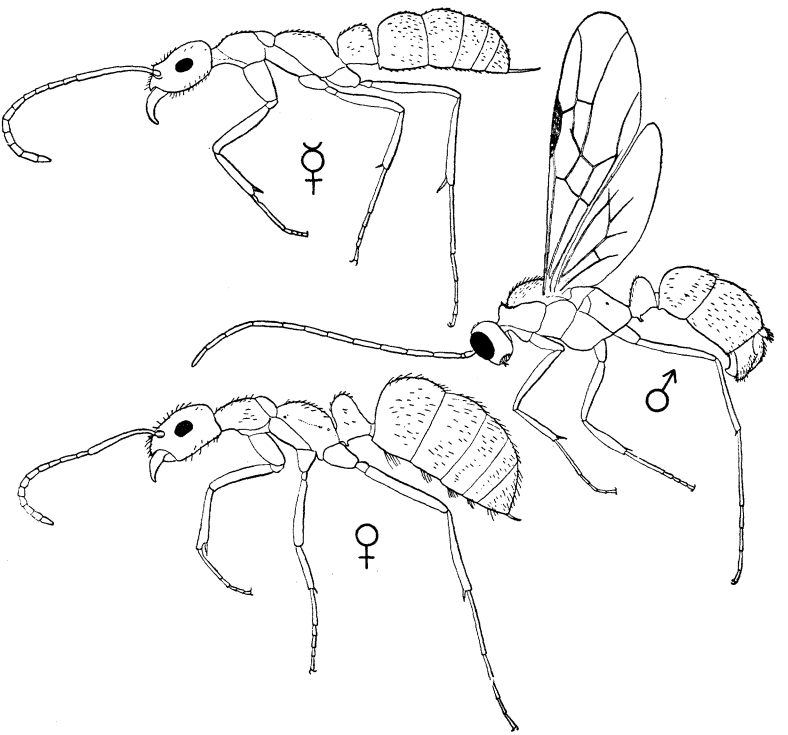

FIG. 4. — *Leptogenys* (*Lobopelta*) *elongata* Buck. Worker, winged male, and apterous female.

but the shape of the node and of the abdomen serves to distinguish them at once from the workers (see Fig. 4, ♀). They are certainly ergatoid females, but as such they differ from the ergatoid females of *P. harpax* in several respects: First, they resemble the workers less closely; second, they occur singly in the nests; and, third, they have the status of true queens,

[1] Thus Emery's supposition (Emery, C., "Zur Biologie der Ameisen," *Biol. Centralbl.*, Bd. xi, p. 174, 1891), that the females of this genus are apterous, is proved to be true of at least one species.

because they are the only known egg-laying individuals of the species. The winged, light-yellow male of *L. elongata* was determined on circumstantial evidence, as it could not be found in the natural nests, nor bred from the cocoons in the artificial nests. What seemed to be the males (Fig. 4, ♂) were found during the autumn and spring flying about the lights in the houses. They are somewhat smaller than the workers, have very large eyes and ocelli, and the node is shaped like that of the female. When placed in the artificial nests of *L. elongata* they are not only not molested, but move about among the workers as if they had always belonged among them. To one who has witnessed the hostility of these ants to any ant of a different species placed in their nest, this amicable reception amounts to a demonstration of specific identity.

During the course of my observations I have had frequent opportunity to observe the conduct of all three species of Ponerinae towards ants of the same or of different species introduced into their nests. They are always hostile to ants of a different species, but the aggressive nature of this hostility varies according to circumstances. If one or a few strange ants be placed in a nest of Ponerinae, they will be at once attacked and killed by concerted action, but if a single Ponerine be placed in the nest of another species — say in a nest of the agricultural ant (*Pogonomyrmex barbatus*) — it will if attacked defend itself valiantly with its mandibles and sting, but it will prefer to seek refuge in some corner of the nest and remain concealed. Single specimens of *P. harpax*, introduced at different times into the nest of *P. barbatus*, managed to evade the pugnacious agriculturals and to remain alive for days. Whenever they left their concealment, however, they would be attacked by a swarm of agriculturals, but the Ponerinae were so supple and fierce that they always managed to throw off their assailants and to conceal themselves. Other investigators, like Forel and Wasmann, have called attention to this difference in the pugnacity of ants according to whether they find themselves alone or backed by numbers of their own species.

The species of Ponerinae differ in their reception of ants of the same species from other nests. If two nests of workers

of *P. harpax* (including ergatoid females) be thrown together into the same jar, the ants of different nests at once begin to struggle with one another. One ant will grasp a stranger by the head with her mandibles and smite her with rapidly vibrating antennae; or the two foes will interlock mandibles and pull in opposite directions till one gives up and runs away, only to begin the same performance with some other stranger. This peculiar tugging goes on between the ants of different nests for hours, or even for three or four days. Then, without any mutilations or deaths as a result of the struggle, the ants abandon all this hostile play, and thenceforth form a single peaceable community.

When two nests of workers of *L. elongata* are put together, the struggle which ensues presents a slightly different aspect. An ant from one nest will grasp a stranger by an antenna or by one of her fore feet and, while tugging, smite her opponent with very rapidly vibrating antennae. In this species there is no interlocking of mandibles. After several days of tugging and struggling the same peaceable conditions supervene as in the case of *P. harpax*.

Workers of *O. haematodes*, belonging to different nests, never display the slightest animosity towards each other, so far as I have been able to observe: in a strange nest they are treated exactly as if they had always belonged there. An exception to this conduct of *O. haematodes* in the case of friends deprived of their antennae will be mentioned below.

A few observations were made on the conduct of nests of workers towards sexual individuals from other nests. One of the two males of *P. harpax*, taken March 3, was placed in a strange nest of ten workers (including ergatoid females). The male, after walking about on the earth for a short time, found his way into one of the galleries in which six of the wingless individuals were digging. On perceiving the male they at once stopped their work and began licking the winged stranger with signs of great agitation and affection. At the same time they carefully massaged all his limbs and segments with their mandibles. During this effusion the attitude of the male was most peculiar. He lay on his back in what may be described

as a pupal attitude, with his legs drawn up against his body, and his long filiform antennae folded against the mid-ventral surface of his thorax and abdomen. This amusing scene was still in progress when I had to quit my observations half an hour later. The next morning I saw one of the workers (or an ergatoid female?) carry the male in her mandibles a distance of four inches and disappear with him into one of the galleries. During transport the male preserved the motionless pupal attitude. This treatment of a strange male contrasts strikingly with the treatment received by the male which was allowed to remain with the workers and ergatoids of his own colony. After eight days of captivity this male was killed and devoured by one of the wingless individuals. When I first observed this Amazon, she had already consumed the small head of her victim and was hanging from the roof of a gallery, twirling the torso about with her feet and rasping away the thoracic muscles with her maxillae. Was this act prompted by hunger? or had the male fulfilled his mission in this nest already provided with several packets of eggs? I have already mentioned the fact that the male of *L. elongata* was received by a strange colony of workers like an old acquaintance. The absence of any display of affection in this case may have been due to the fact that there were no females in the nest. Two strange females introduced into this same nest at different times were at once surrounded and attacked by the workers, and although the colony was without a queen, they were either maimed or killed during the course of the day.

Many of the habits of the Ponerinae closely resemble those of other ants. All the habits relating to the cleanliness of the individual ants and of the nests are the same as those of the Myrmicinae and Formicinae. They clean themselves and one another with great care. The males spend much of their time drawing their delicate antennae through the strigils on the fore feet. The nests of all the species are kept scrupulously clean — all refuse, inedible fragments of their insect prey, empty cocoons, dead sister ants, etc., are carefully deposited in one of the corners of the nest exposed to the light and as far as possible from the chambers in which the young are reared.

In digging a gallery *P. harpax* first uses its feet and powerful mandibles in removing the earth, after the manner of the digger-wasps, but as soon as the gallery is sunk to a certain depth, only the jaws are used in removing the lumps of earth.

Emery's observations[1] show that the Ponerinae have the power of stridulating. He has even been able to produce the sound in preserved specimens of certain American species, including species of Pachycondyla. Although the ants observed by me occasionally moved their abdomens as if stridulating, no sound could be detected.

The sting of the three species of Ponerinae, although of formidable length, does not inflict severe pain, at least when compared with the sting of the agricultural ant (*Pogonomyrmex barbatus* Sm.). The pain may be acute for ten or fifteen minutes, but then disappears, often without even reddening the skin; whereas the sting of Pogonomyrmex produces a throbbing pain which endures for hours and is sometimes accompanied by a sensation of sickness.

The Ponerinae do not seem to feed one another, like the specialized ants. In captivity *P. harpax* would eat the yolk of egg or even sugar, but it would not eat termites. *L. elongata* devoured termites and small caterpillars with avidity, but would not eat flies. *O. haematodes* is more omnivorous; besides caterpillars, house-flies, beetles, and small Hemiptera, it will eat sugar, bread, cake, etc.

Pachycondyla and Leptogenys are like other ants in their methods of killing their prey or in feeding upon it, but Odontomachus is most exceptional in these particulars. Its whole life, apart from the care of its young, appears to center in its peculiarly constructed mouth. The long linear mandibles with hook-shaped dentate tips are inserted close together. They are usually carried wide open, as represented in Fig. 1, while the ant is moving about in search of food or while it is feeding. The cutting edges of the mandibles are furnished with some sensory hairs, two of which, nearly as long as the mandibles, are inserted near the base and point directly forward

[1] Emery, C., "Zirpende und springende Ameisen," *Biol. Centralbl.* Bd. xiii, pp. 189–190. 1893.

when the mouth-parts are in the position represented in Fig. 1. The slender antennae, too, are carried in a peculiar position, their tips being directed inwards. The touching of a living insect or of any unfamiliar object with these incurved tips calls forth a peculiar response, which seems to be largely of a reflex nature. The ant darts forward and suddenly closes its mandibles with a very audible click. The signal for closing the mandibles seems to be given the moment the long sense-hairs touch the object. The mandibles are brought together with such force that if they strike a solid object the ant is thrown backwards — often to a distance of three or four inches — occasionally even to a distance of ten or twelve inches. The ant alights on its feet, like a cat, and again advances to repeat the act. This remarkable clicking and leaping habit is called into play on every occasion, and its study discloses some interesting facts, as the following jottings from my notebook will show:

May 12. Placed a living house-fly in the Odontomachus nest. Its movements at once attracted several ants, which began snapping at it like a pack of angry dogs. With each snap a leg or wing was severed and often thrown to a distance of 2 or 3 inches. In less than a minute all the limbs had been shorn from the trunk. The fly was then seized and decapitated. Next the following living ants were placed in the nest in succession: *Eciton sumichrasti*, *Pogonomyrmex barbatus*, and *Leptogenys elongata*. The first and last were reduced to torsos as rapidly as the fly; the harder legs and antennae of the Pogonomyrmex offered greater resistance, but not for long. The stings and strong mandibles of these various ants were no protection against the singular method of attack adopted by the Odontomachus. A smooth green caterpillar was next introduced into the nest. It was at once surrounded and attacked by a dozen ants. At first the ants retreated from the writhing larva after each snapping of the mandibles, but soon they grew bolder and, retaining their hold, drove their stings through its velvety skin. One ant with a dexterous movement closed its mandibles in the caterpillar's brain. In a few moments the green blood of the victim was oozing from a score of wounds.

May 25. *O. haematodes* reacts to lifeless objects just as it does towards living insects. If the points of a pair of tweezers be held in the nest and rapidly opened and closed, they at once become the center of a swarm of snapping and leaping ants. A small glass vial dropped into the nest at once begins to tinkle under the blows of the alternately advancing and retreating emmets. A lump of sugar is attacked in the same manner for some moments, till the ants learn that it is edible, when they settle down on it and lap its crystals with avidity. Even soft viscid or liquid substances, like the yolk of egg, poured on the floor of the nest, at once release the same peculiar response. As soon as the ants perceive it with the contact-odor sense of their antennae, they begin snapping at it as if it were a deadly foe. In this case the tips of their mandibles are smeared with the yolk. This causes them to feel some discomfort apparently, and they wipe them on the hard floor of the nest, much as a bird would wipe its beak in similar circumstances. It is only after several repetitions of this performance that they approach the yolk without closing the mandibles. Then they begin to eat it, and some hours later they begin to cover it up with little pellets of earth, for *O. haematodes*, as well as *L. elongata* and *P. harpax*, share with the Myrmicine and Formicine (and I may add, also, the Doryline ants!) the habit of burying offensive substances.

Observers[1] have called attention to the fact that ants deprived of their antennae are in some cases attacked and killed by ants of the same nest. A few experiments were tried for the sake of testing these observations on Odontomachus. One of these ants, deprived of both antennae, was replaced in the nest from which it had just been taken. It was at once fiercely attacked by several ants as if it had been a strange insect. It stopped, as if dazed, unable to meet its sister workers with the customary antennal greeting. The ants, however, soon perceived their error, and a few hours later one of them was licking and fondling the mutilated ant. By the next day the mutilated ant was dead, probably as a result of the

[1] Forel, Fourmis de la Suisse, p. 119, *et al.*; Wasmann, Die zusammengesetzten Nester und gemischten Kolonien der Ameisen, pp. 151, 152, Münster i. W., 1891.

extirpation of its antennae. Two other experiments terminated in the same way.

Two inferences may, I believe, be drawn from these observations on the snapping and jumping habits of Odontomachus: First, it seems evident that these are reflex actions; second, that they can be inhibited by the will of the insect. This latter conclusion is supported by the experiment with the sugar and the yolk. It also shows that these ants learn by experience, and that they possess some form of memory.

The peculiar snapping and leaping habits of *O. haematodes* have been remarked by a few other observers. Emery has published a brief note on this subject,[1] and Forel[2] says of this insect that "en Colombie on l'appelle 'Fourmi tac', à cause du bruit qu'il fait en refermant brusquement ses mandibules. Par le même mouvement il ressaute en arrière lorsqu'il les referme contre un objet, ce qui lui a fait attribuer à tort la propriété de sauter." I cannot accept this last statement, which seems to be a contradiction in terms. The ant makes use of its saltatory powers for purposes of escape, as any one who tries to capture a colony of these ants may readily observe. That it leaps backward instead of forward, like other insects, is due to its using a most unusual organ for leaping, for the mandibles, which, as in other ants, are used for digging and transporting the soil, carrying eggs and larvae, and for killing and cutting up prey, have acquired an additional function as saltatory organs in *O. haematodes*.

The breeding habits and the characteristics of the eggs and larvae of the Ponerinae exhibit striking deviations from those of other ants. I have not seen the eggs of Odontomachus, but throughout the month of May I have often happened on the eggs of Pachycondyla and Leptogenys. These are white and of a slender, oblong shape (Fig. 8, *a*), somewhat smaller in the latter than in the former genus. They differ in shape from the eggs of species of Eciton, Camponotus, Formica, Pogonomyrmex, Solenopsis, and Tapinoma; for the ants of these genera, representing several subfamilies, agree in having elliptical and

[1] *Biol. Centralbl.* Bd. xiii, pp. 189–190. 1893.
[2] *Loc. cit.*, p. 20.

much less slender eggs than the Ponerinae. The Ponerinae also keep their eggs in more regular packets, the long axes of the different eggs being placed parallel with one another. I have not been able to determine the length of embryonic development with accuracy. It seems to be much protracted, as in other ants. Some eggs of *P. harpax* in an artificial nest had not hatched at the end of five weeks.

The larvae of the Ponerinae differ from those of all other ants in several particulars, first made known by Emery.[1] Emery describes and figures the larvae of *Ponera stigma* Fab. (New Guinea), *P. caffraria* F. Sm. (Cape Colony), *Diacamma rugosum-geometricum* F. Sm. (Celebes), and *Odontomachus haematodes* L. (Cayenne). All of these larvae agree in having the mandibles powerfully developed for ant-larvae, the anterior portion of the body long and slender and folded over the abdominal portion, and in being covered with rows of peculiar tubercles beset with more or less prominent bristles.

The larvae of Pachycondyla and Leptogenys are here figured for the first time. I have seen fit to figure also the Odontomachus larvae because my material was evidently in fresher condition than that depicted by Professor Emery. The larvae of the three genera may be arranged in a series beginning with Odontomachus and terminating with Pachycondyla.

The young larva of *O. haematodes* is represented in Fig. 5, *a*, which shows the arrangement and character of the bristly tubercules and the neck-like anterior portion, consisting of the head, the three thoracic and the first two abdominal segments. The remaining eight abdominal segments are much enlarged and flattened ventrally. The larva is kept on its back, and the neck-like anterior portion rests against the flattened ventral surface. The shape of the tubercles, each of which is tipped with a rigid bristle and encircled with bristles, is shown in Fig. 5, *b*. The larva was about to moult, so that the tubercle of the succeeding cuticle is seen shining through the old one. The adult larva is shown in Fig. 6, *a*. Compared with that of the young larva, its head is very small in proportion to the body.

[1] "Intorno alle Larve di Alcune Formiche," *Mem. della Accad. delle Scienze dell Istituto di Bologna*, 7. Maggio, 1899, 2. Tavole.

This seems to be the universal rule in ant larvae. The head in dorsal view is represented enlarged in Fig. 6, *b*. The powerful dentate mandibles lie just below the outer edges of the bilobed labrum ; still lower and projecting forward lies the labium, bearing on its tip the opening of the spinning gland (to be used in weaving the cocoon), and on either side two peg-shaped tactile (?) organs. Similar but somewhat larger organs are seen on the edges of the maxillae, which protrude on either side below the mandibles. The ten tracheal stigmata, begin-

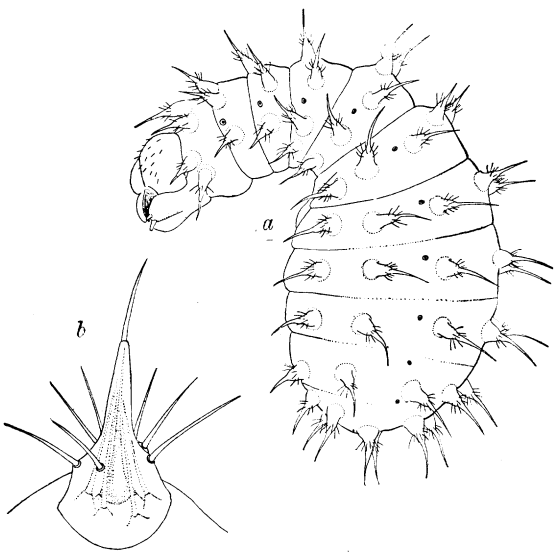

FIG. 5. — *Odontomachus haematodes* Linn. *a*, young larva ; *b*, tubercle of the same.

ning on the mesothoracic and terminating on the eighth abdominal segment, are clearly shown in Fig. 6, *a*. The bristly tubercles are essentially the same in structure as those of the younger larva, but they are relatively shorter and smaller. (*Cf.* Fig. 5, *b*, and Fig. 6, *c*.)

The larvae of Leptogenys (Fig. 7) are remarkably slender and scarcely flattened on the ventral surface. In the young larvae (Fig. 7, *a*) the tubercles are distinctly curved and pointed, without apical bristle, and with only a few rather short bristles encircling the base (Fig. 7, *d*). In the adult larvae (Fig. 7, *b* and *e*) the tubercles are larger and shorter, with blunt or

acuminate apex and with relatively longer and more numerous basal bristles. The head of the adult larva (Fig. 7, *c*) is remarkable for its length and the narrowness of the labrum, which is nearly as long as the slender mandibles and provided with a median tooth at its tip.

The larvae of Pachycondyla (Fig. 8) are neither as slender as those of Leptogenys nor as robust as those of Odontomachus.

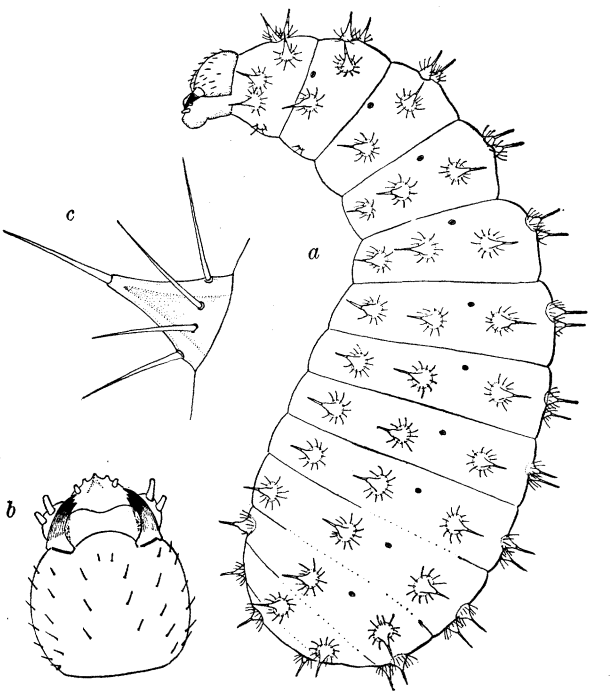

FIG. 6. — *Odontomachus haematodes* Linn. *a*, adult larva; *b*, head of same (dorsal aspect); *c*, tubercle.

The ventral surface of the abdomen is distinctly flattened. The head (Fig. 8, *e*) resembles that of Odontomachus, especially in the shape of the labrum and mouth-parts. There is a striking difference between the tubercles of the very young and the adult larva. In the former (Fig. 8, *b*, *c*) the tubercles are nearly or quite straight, and somewhat longer and more pointed than those of Leptogenys. They lack the terminal bristle. The bristles about the base are somewhat irregular in their insertion.

In the adult larva (Fig. 8, *d*) the tubercles are reduced to large more or less flattened bosses, encircled with a regular row of numerous, rather long bristles. In the stages between those figured the gradual flattening of the juvenile spine-like tubercles can be traced through the successive moults.

In this series of larval forms, Odontomachus seems to represent the most primitive condition. Here both young and old larvae have pointed, bristle-tipped tubercles, and there is little

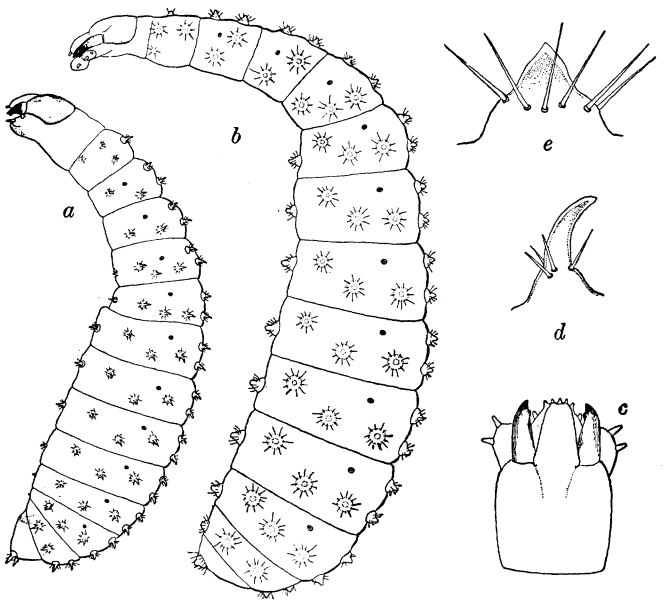

FIG. 7. — *Leptogenys* (*Lobopelta*) *elongata* Buck. *a*, young; *b*, adult larva; *c*, head of adult larva (dorsal aspect); *d*, tubercle of young; *e*, tubercle of adult larva.

difference between the tubercles of the young and adult. In Leptogenys and Pachycondyla the apical bristle is absent, but in both genera the young larvae have pointed tubercles. In the adult larva of the former genus there is a perceptible blunting of the tubercles, while in the adult larva of the latter the tubercles have nearly subsided.[1]

[1] Emery's observations on *Ponera stigma*, *P. caffraria*, and *Diacamma geometricum*, seem to indicate conditions the reverse of those which I have described. Of the former species he says (*loc. cit.*, p. 4); "Nello stado piu giovane, si vedono solo deboli accenni dei tubercoli cutanei; ritengo che questo stado debba corrispondere alle larve di prima schiusa e che lo stado seguente, di poco piu grande, sia quello

The bristly tubercles of the larvae of the Ponerinae are so prominent as readily to suggest the question of their function. Prof. L. Biró, who made some observations on the larvae of *P. stigma,* which he sent to Professor Emery, believes that the pointed tubercles are organs of defense. He saw these larvae when disturbed by some termites move their long necks back and forth with sufficient force to drive away the intruders.[1]

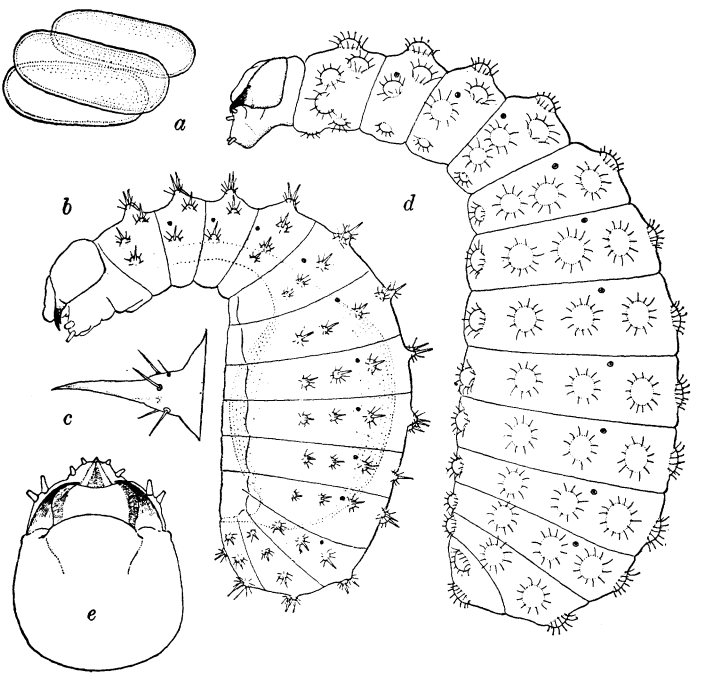

FIG. 8. — *Pachycondyla harpax* Fabr. *a*, eggs; *b*, young larva; *c*, tubercle of the same; *d*, adult larva; *e*, head of the same.

che segue la prima muta; questi si fanno successivamente piu numerosi e sporgenti, a misura che la larva cresce." In the larvae of Diacamma a very different condition is described: "Sopra ciascuno (segmento) di essi si trova un serie transversale, irregolare di tubercoli conici, ineguali che, nelle larve piu sviluppate, portano da uno a quattro peli. Nelle piccole larve, i tubercoli sono piccoli, subcilindrici e senza peli; negli stadi intermedii passano per una forma acuminata con pochi peli."

[1] Professor Emery (*loc. cit.*, p. 4) quotes from Professor Biró's letter: "Nelle gallerie del nido scavato nel legno putrido, si trovavano le larve dal lungo collo, coperte di spini singolari: abbandonate dai loro vigliacchi custodi, quelle larve sapevano difendersi da se; quando qualche termite (il nido di queste trovavasi nello stesso legno) si avvicinava ad una di esse, questa batteva innanzi e indietro col suo collo di cigno e tosto veniva lasciata in pace."

Biró's observations may be true of *P. stigma* without being applicable to the three forms of Ponerinae which I have observed. In artificial nests I have seen the neck movements of the larvae, but they were often executed when the larva was undisturbed, except perhaps by the pangs of hunger, and they were not always made when termites or other insects were running about and over them. Moreover, we should expect to find the tubercles more highly developed on the neck than

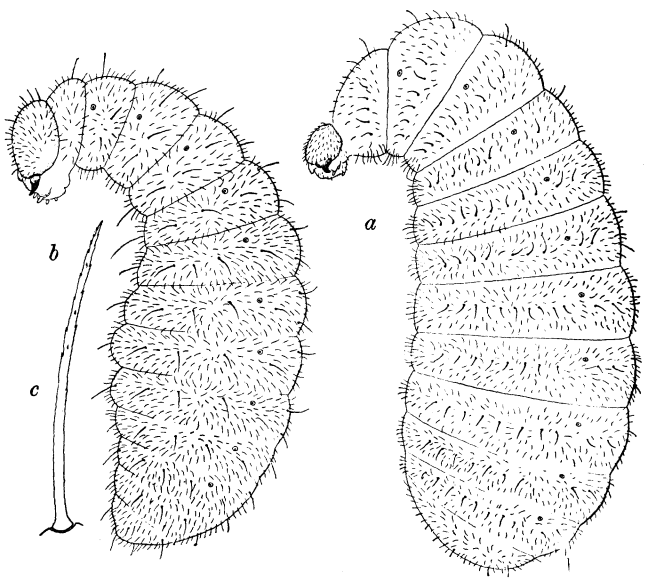

FIG. 9. — *Pogonomyrmex barbatus* Smith. *a*, nearly adult larva; *b*, young larva; *c*, serrated bristle of the same.

on the body, if they are really used as Biró suggests. I believe that while they may be organs of passive defense, like the somewhat similar tubercles and spines of certain caterpillars, they also fulfill other functions; they would seem to facilitate the carrying of the larvae either singly — when full-grown — or in batches — when young — by the worker ants. In the last instance they would represent a peculiar form of the "poils d'accrochage" carefully studied by Janet.[1] Janet finds that the young larvae of the more specialized ants are covered with

[1] Les Fourmis. Conférence faite le 28 Février, 1896. Paris, 1896.

hooked bristles, which cause them to adhere together in packets and thus facilitate their transportation by the workers. The appearance of these peculiar hairs in the young and half-grown larvae of one of our common Texas ants, *Solenopsis geminata* Fabr., is shown in Fig. 10. The very young larvae have only simple bifurcated hairs, but when half-grown they have on the dorsal surface of several of the segments, besides a much greater number of these simple bifurcated hairs, several rows of long and peculiarly contorted bristles, terminating in short

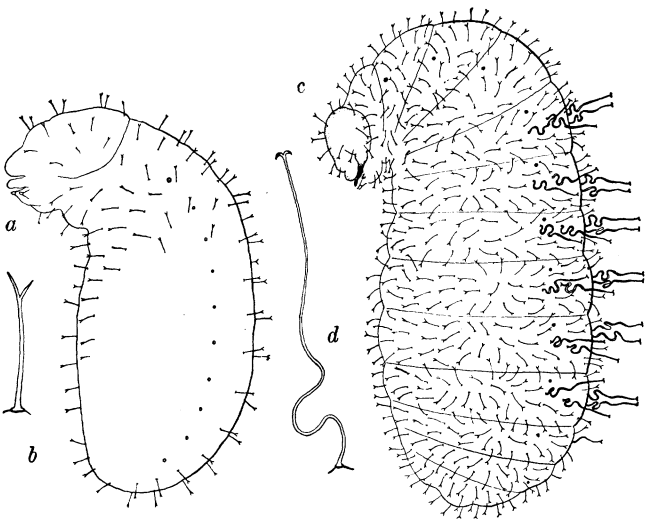

FIG. 10. — *Solenopsis geminata* Fabr. *a*, very young larva; *b*, furcate bristle of same; *c*, half-grown larva; *d*, contorted furcate bristle of same.

bifurcations. Still another modification of the "poils d'accrochages" is seen in *Pogonomyrmex barbatus* (Fig. 9), the young larvae of which have the longer bristles serrate on the apical half, so that they remind one of the hairs of certain mammals. All of these modifications — the bristly tubercles of the Ponerinae, the simple and contorted bifurcated bristles of Solenopsis, the serrate bristles of Pogonomyrmex, and possibly also the fascicles of uncinate hairs described and figured by Emery (*loc. cit.*) for the larva of *Sima natalensis* F. Sm. — seem to subserve the same purpose — a most interesting example of independent

lines of development terminating in organs of different structure but identical function.

The pupae of Odontomachus, Leptogenys, and Pachycondyla are enclosed in elliptical brown cocoons, like the pupae of many species of Formica and Camponotus. The pupa of *L. elongata* is remarkable on account of its very slender shape, a peculiarity not confined to the pupa, but, as we have seen, extending also to the egg, larva, and imago.

We come now to a consideration of the breeding habits of the Ponerinae. The little that has been made known concerning their habits has led European myrmecologists to believe that the philoprogenitive instincts of these ants must be less highly developed than those of the Myrmicinae and Formicinae. Thus, according to the above-quoted note of Professor Biró, when the nest of *Ponera stigma* is disturbed the ants flee and the larvae are "abbandonate dai loro vigliacchi custodi." And Professor Forel has made what appears to be a somewhat similar observation on our American *Ponera coarctata* Fabr. in North Carolina[1]: "La *Ponera coarctata* americaine est très commune dans les troncs pourris et sous les pierres. J'ai fait chez elle une observation qu'il est bien difficile de faire en Europe; mais ici elle est tout à fait constante. Lorsqu'on découvre un nid de Ponera dans un tronc pourri, on voit leurs cocons jaunes assemblés dans un coin, mais absolument abandonnés des ☿ qui n'essaient pas de les sauver, ni de les recueiller. Par contre, elles prennent le plus grand soin des larves qu'elles emportent et cachent. Je soupçonne que chez ces fourmis, moins sociales que les autres, les nymphes sortent seules de leurs cocons, sans avoir besoin de l'aide des ☿."

These observations relate to species of Ponera and are at variance with the conclusions which I have reached from a study of three other genera of Ponerinae. In many of the nests which I have examined the total number of the eggs, larvae and pupae, could scarcely be greater than one and one-half to twice the number of the ants. This fact, together with what has been said of the small number of eggs laid at one time by a single female, shows very clearly that the Ponerinae

[1] *Ann. de la Soc. Entomol. de Belgique.* Tome 43, p. 443. 1899.

are not nearly so prolific as the species of Camponotus, Formica, Pogonomyrmex, Pheidole, Tapinoma, Eciton, etc. Indeed, the small number of ants in the nests of the Ponerinae is probably the direct result of this limited productivity. If this is the case, it does not seem probable that these ants would be more careless of their progeny than the very prolific specialized ants. On the contrary, we should expect them to extend even greater protection to their offspring. This my observations show to be the case; at any rate, *P. harpax*, *L. elongata*, and *O. haematodes* are in nowise inferior to the Myrmicinae and Formicinae in this respect. The slightest disturbance of the natural or artificial nests of these ants causes them at once to seize their eggs, larvae, and cocoons, and to make for their galleries. Occasionally some of the ants escape without anything, but if they are watched for a few moments, they will be seen returning, often in the very face of danger, to carry off more of their young. They are, it is true, most careful of their eggs, somewhat less careful of the larvae, and least careful of their cocoons; but these distinctions are not always apparent and can only be affirmed as the result of many observations. When the colony is agitated, it is probably most easy for the ants to seize and remove the small packets of eggs and the younger larvae, and least easy to carry off the larger larvae and the awkward cocoons. Dead pupae are often collected in one part of the nest and are there allowed to lie unheeded. I am inclined to think that Professor Forel may have seen such abandoned pupae in the nests of *P. coarctata*.

The strong development of the mandibles of the Ponerine larva as compared with those of other ants led Emery remotely to surmise the method which the Ponerinae employ in feeding their young.[1] But no myrmecologist could have predicted the

[1] *Loc. cit.*, pp. 8, 9. "Sembrami pertanto che lo sviluppo notevole della bocca e particolarmente delle mandibole, nelle larve delle Ponerinae e dell' Acanthostichus inducano a qualche supposizione relativamente alla biologia di queste formiche. Le larve delle specie europee che finora furono osservate vengono alimentate col contenuto dell' ingluvie delle operaie che queste regurgitano sulla bocca delle loro larve, e forse anche col secreto di ghiandole salivari. In queste specie, l'alimento delle larve consiste dunque esclusivamente di sostanze liquide o

remarkable and un-ant-like procedure which I have been able to observe in the three Texan species.

My first observation on this singular method of feeding the larvae was made on a large nest of Pachycondyla found under a stone at the foot of Mt. Bonnell, near Austin, May 5. Before the ants could carry them away, I had scooped up a fine lot of larvae, together with the earth in which they were lying. Among the larvae were several pieces, one or two segments long, of a recently killed myriopod (Scutigera). Into these pieces the larvae, some of which were nearly full-grown, had inserted their heads and were devouring the softer tissues! This could be distinctly seen with the pocket lens through the glass of the vial to which the larvae had been transferred. In another nest of the same species, uncovered May 16, I observed the larvae in the nest lying on their backs, devouring the pieces of some insect which I could not identify.

The former of these observations made in the field led me to observe the feeding of the larvae in my artificial nest of Leptogenys. I had frequently wondered at the way in which these ants decapitated termite nymphs or cut off their abdomens and scattered these about among their larvae. It was all quite clear to me now; examination with the lens showed that the larvae had inserted their long necks through the cut surfaces into the soft parts of the termites and were feeding exactly like the larvae of Pachycondyla.

During the month of May I had frequent opportunity to see Odontomachus feeding its larvae in my artificial nests. These larvae are placed by the ants on their broad backs, and their heads and necks are folded over onto the concave ventral surface, which serves as a table or trough on which the food is placed by the workers. The following observations are transcribed from my notebook:

semiliquide; e tale é pure in massima l'alimento delle stesse formiche allo stato adulto, quando si cibano di sostanze zuccherine vegetali o degli escrementi liquidi degli afidi. Però, molte formiche vivono pure in parte di preda, e nulla prova che si contentino di sorbire i succhi della loro vittima, e non digeriscano pure, mediante la saliva, alcune parti solide." . . . "Ora sarebbe pure possibile che Formiche, le quale vivono principalmente di preda, diano in pasto alle loro larve pezzi più o meno triturati del corpo delle loro vittime come fanno le Vespe."

May 13. This evening several house-flies, placed in the Janet nest of *O. haematodes*, were at once shorn of their legs, then decapitated, and finally their thoraces and abdomens were cut into smaller pieces and distributed among the larvae. One was given a fly's head, which it kept twirling around in a comical manner, while it devoured the brain through the small cervical orifice. Another was given a piece of a thorax with one of the wings still attached, another a piece of an abdomen, still another, a leg with a mass of muscle at its coxal end, etc.

May 16. This evening a small homopterous insect was placed in the Odontomachus nest. One of the ants (A) snapped at it, disabled it, and then left it. A few moments later it was picked up by another ant (B) and carried into the chamber containing the larvae and pupae. Thereupon a third ant (C) took hold of it and began tugging at it with B till it was torn open, but not into pieces. B then placed it on the flat ventral surface of a medium-sized larva, which began feeding at once, moving the homopteron around with its jaws. After four minutes had elapsed, another ant (D) that had been standing near by, apparently much interested in the feeding, suddenly tore the morsel away and placed it on a small larva. This larva was permitted to feed ten minutes, closely watched during all this time by ant D and another (E) which had come up in the mean time. Then ant D tried to tear the morsel away from the small larva, but apparently unable to do so, it took up the larva with the morsel and dumped them both on the ventral surface of a large larva. This creature seized the homopteron and forced the small larva to release its hold and to drop to the ground. The large larva fed for fully twenty minutes, closely watched by ant D and two others (E and F). All of these ants tried at different times to wrench the morsel away from the larva, but failed. Suddenly a small ant (G) rushed up, tore it away, and ran off with it. By this time very little was left of the homopteron and I lost track of it.

May 23. A few crumbs of cake, moistened with water, were placed in the Odontomachus nest at 11.7 P.M. A worker soon carried one of the crumbs into the breeding chamber and gave

it to a large larva at 11.20. This larva fed but a few moments, but the cake was not removed till 11.35, when it was carried into another chamber, then at once brought back and placed between three larvae, from one of which it had just been taken. The smallest of these three larvae nibbled at it for a short time, beginning at 11.40. But one minute later this larva was carried away by a worker, and the cake was taken by another worker and given to a small larva at 11.43. This larva, too, was soon carried away (at 11.48), and the cake was taken to a large larva, which would have none of it. It was not removed, however, till 11.50. Then it was given by another worker to a large larva, which did eat some of it. At 11.51 the piece of cake, but little diminished in size after all its perambulations, was taken to another large larva. The ant remained over the larva holding the cake in place till 11.58, when another worker came up and ran away with the larva. While the larvae were feeding, the ants themselves could be plainly seen to partake of the cake from time to time. During the whole period of the above observations, and for some minutes later, *i.e.*, for over an hour, one little larva was permitted to feed without interruption on what seemed to be a piece of a house-fly.

These observations lead us to several interesting reflections. First, it is certain that the feeding of the larva of the Ponerinae is of a far more primitive character than in any other ants in which this process has been studied. It is, in fact, even more primitive than the corresponding habit of the social wasps, which feed their larvae with masticated insect prey, for in the Ponerinae the prey is cut into a few pieces only, for the purpose of exposing the soft tissues and making them accessible to the mandibles of the larvae. Myriopods or large insects are disarticulated for this purpose, small insects are merely torn open. Leaving the question of systematic affinities out of consideration, the Ponerinae may be said to have habits of feeding the young intermediate between the habits of the solitary wasps, which provide their young with whole insects, and the social wasps, which masticate the food for their larvae. In this statement it may, perhaps, be more accurate to substitute the Bembecidae for the solitary wasps, since the Bembecidae,

which feed their larvae from day to day with entire Diptera in a fresh condition, resemble the Ponerinae more closely than do the solitary wasps, which merely enclose their eggs with paralyzed larvae, spiders, grasshoppers, etc.[1] From the condition of the Ponerinae to that of the more specialized ants, which feed their larvae with nothing but the liquid food regurgitated from their own crops or from their salivary glands, the transition is very abrupt. But there are many ants whose habits have not been studied, and some of these may yet be found to bridge this chasm.

In the second place, the above-recorded observations seem to show that the Ponerine method of feeding the larvae is of a most capricious and irregular character. The quantity and quality of the food given to a particular larva, and the time it is permitted to feed, seem to be matters requiring no very strict regulation. The ants that feed the young rarely act in concert, but rather with a whimsical individualism that seems at times to border on the ridiculous.

This irregular method of feeding suggests other considerations of a wider bearing. It is generally admitted that the polymorphism of the female sex in ants, *i.e.*, the occurrence of fertile females and of sterile females of one or more casts, is in some manner correlated with the feeding of the larvae developed from fertilized eggs. In other words, the worker ants can control the production of individuals like themselves and of individuals like their queen. It is further maintained that these differences are effected by the quantity and quality of the food administered to the larvae at a certain period of their development; but here our knowledge ends. These data have been accumulated from the study of the specialized Myrmicine and Formicine ants of Europe and North America, and are

[1] Fine descriptions of wasps (Polistes) and Bembecids feeding their young are to be found in the charming works of Fabre (Souvenirs Entomologiques, 1° ser., 2m edit., Paris, 1894, pp. 126–128 and pp. 226 *et seq.*) and of Dr. and Mrs. G. W. Peckham ("The Instincts and Habits of the Solitary Wasps," *Bull. Wisconsin Geol. N. H. Survey*, No. 2, 1899, 245 pages, 14 plates). Janet has described the corresponding habits of Vespa ("Études sur les fourmis, les guêpes, et les abeilles." 10. Note. Sur Vespa media, V. silvestris, et V. saxonica, *Mém. de la Soc. Acad. de l'Oise*, tome xvi, 1895, p. 39).

supported by many valuable observations on the hive-bee. Now, while we can, perhaps, understand how these more specialized ants may manage to control the quantity and quality of liquid food regurgitated from their own crops and salivary glands, it is not so easy to understand how ants can exercise such control when they adopt a capricious method of feeding like that of the Ponerinae. Such a method can hardly produce clear-cut results; *i.e.*, either workers or fertile females. And a comparative study of the better known species of Ponerinae shows that in certain species at least there is no such sharp distinction between the sterile and fertile female as we find in the more specialized ants. Not only is the female sex in a state of morphological and physiological instability,—*i.e.*, di- or even tri-morphic,—but the male sex also is sometimes dimorphic — at least in the same genus, if not in the same species. For the purpose of illustrating this singular instability of the sexes I have compiled the following table from the literature to which I have access.[1] It includes twelve of the better known species

Species of Ponerinae.	Winged Male.	Ergatoid Male.	Winged Female.	Ergatoid Female.	Worker Major.	Worker Minor.
Odontomachus haematodes Linn	+		+	+	+	
Pachycondyla harpax Fabr. . .	+		+	+	+	
Cardiocondyla Emeryi Forel . .	+		+	+	+	
Cardiocondyla Wroughtonii Forel		+	+		+	
Cardiocondyla Stambulofii Forel		+	+		+	
Leptogenys elongata Buck. . .	+			+	+	
Ponera ergatandria Forel . . .	? +	+	+		+	
Ponera ochracea Mayr.	+		+		+	
Ponera Eduardi Forel	+		+	+	+	
Ponera coarctata Latr.	+		+	+	+	
Ponera punctatissima Rog. . .		+	+		+	
Stigmatomma pallipes Hald. . .	+		+		+	

[1] Sharp, "Formicidae in Cambridge Natural History," *Insects*, vol. vi; Emery, "Sopra Alcune Formiche della Fauna Mediterranea," *R. Accad. delle Scienze dell' Istituto di Bologna*, 21 Apr., 1895; Emery, "Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna," Schluss, *Zool. Jahrb.*, Abth. f. Syst., Bd. viii.

of Ponerinae. The presence of a particular sexual phase is indicated by a cross.

Although it is by no means certain that the irregular polymorphism of the two sexes of the Ponerinae, as indicated in this table, is due to an inability on the part of the ants to regulate with precision the quality and quantity of the food administered to the larvae, I nevertheless believe that there is some causal connection between these two peculiar phenomena. At any rate, we may assume this connection as a working hypothesis for future experimentation and observation. I believe that continued study of the relatively undifferentiated sexual conditions of the Ponerinae may lead us more rapidly to a solution of the interesting problems of nutritional polymorphism than a study of the more specialized ants.

When the larvae of the Ponerinae are mature they are, like the mature larvae of the Formicinae, buried in the soil till they have spun their cocoons. They are then unearthed and the small adherent particles of soil are carefully removed by the workers. I have watched the burying of the larvae in Leptogenys and the unearthing and cleansing of the cocoon in Odontomachus. The cocoons of the three species of Ponerinae are usually kept together, but the ants are scarcely as careful in this respect as the species of Formica and Camponotus which I have observed (*F. neorufibarbis* and *C. castaneus*). Nor do they keep their larvae assorted according to sizes, a peculiarity which accentuates the irregularity of their feeding habits.

Forel, as we have seen, believes that *Ponera coarctata* may escape from its cocoon without the assistance of the workers. Unfortunately I had to leave my work at Austin before the pupae of Odontomachus were ready to hatch, but I am convinced that Leptogenys, at any rate, opens the cocoon and draws out the pupa when ready to enter on its imaginal life. I have not seen this operation under normal circumstances, as the two workers which appeared as callows in my artificial nest left their cocoons when I was not present, but for some reason the workers in this nest were continually opening the cocoons near one end and pulling out the still white pupae. Ten or a dozen workers would gather about

one of these extracted pupae and lick it for hours. Sometimes one ant would take possession of the limp thing and hold it astraddle for a long time. Ultimately these prematurely born ants were either devoured by the workers or fed to the ravenous larvae. Nevertheless the deft manner with which the cocoon was opened, the pupa extracted, and the empty cocoon at once placed on the kitchen-midden, or rubbish heap, indicated very clearly that this is also the method of procedure with pupae that have reached their full growth.

A word in conclusion concerning myrmecophiles, for the Ponerinae, like the other subfamilies of ants, are known to harbor arthropod guests in their nests.[1] No guests were taken with Odontomachus and Leptogenys, but some six different species were observed in various nests of *Pachycondyla harpax*. Only one of these had not previously been found in the nests of other species of ants near Austin. This was a small yellow ant, a Solenopsis, allied to the European *S. fugax*, and found inhabiting some very minute galleries in the earth between the huge burrows of the Ponerine. It is probably a "Diebsameise," given to myrmecoclepsy like its European

[1] The Ponerine guests enumerated by Wasmann in his Kritisches Verzeichniss der myrmekophilen und termitophilen Arthropoden, Berlin, 1894, are the following: *Typhloponemys hypogaea* Rey (staphylinid beetle), with *Typhlopone oraniensis* Luc., Palestine; *Apocellus* (?) *sphaericollis* Say (staphylinid), with *Ponera coarctata* Latr., North America; *Mesotrochus paradoxus* Wasm. (staphylinid), with *Typhlomyrmex Rogenhoferi* Mayr, Santa Catharina; *Euplectus Sikorae* Wasm. (pselaphid beetle), with *Ponera Johannae* Forel, Madagascar; *Trichonyx sulcicollis* Rchbch. (pselaphid), with *Ponera coarctata* Latr., Europe; *Amauronyx Märkeli* Aubé (pselaphid), with *Ponera coarctata* Latr., Switzerland; *Araniops amblyoponica* Brend. (pselaphid), with *Stigmatomma pallipes* Hald., Pennsylvania, North Carolina; *Tmesiphorus formicinus* McL. (pselaphid), with *Ectatomma sociale* McL., Australia; *Leptotrichus inquilinus* Koelbel (isopod crustacean), with *Ponera senarensis* Mayr, East Africa. More recently Wasmann has described the following ponerinaphiles: *Fauvelia permira* Wasm. (staphylinid), with *Pachycondyla Fauveli* Emery, Bolivia ("Die Ameisen- und Termitengäste von Brasilien," 1. Theil, *Verhandl. d. k. k. zoöl. bot. Gesell.*, Wien, Jahrg. 1895, pp. 40, 41); *Lomechon Alfaroi* Wasm. (silphid), with *Pachycondyla aenescens* Mayr, Costa Rica ("Ein neues myrmekophiles Silphidengenus aus Costa Rica," *Deutsch. Ent. Zeitschr.*, Heft. ii, 1897); *Myrmedonia lobopeltina* Wasm. (staphylinid) and *Demera Fauveli* Wasm. (staphylinid), with *Leptogenys* (*Lobopelta*) *nitida* Sm., Natal ("Zwei neue Lobopelta-Gäste aus Südafrika," *Deutsch. Ent. Zeitschr.*, Heft. ii, 1899).

congener. Two specimens of the very singular little ant, *Strumigenys louisianae* Rog., were also taken from the earth of this same nest. Their relations with the Pachycondyla were probably of a more accidental nature. The other forms taken are pleomyrmecophilous, *i.e.*, they occur in the nests of several other species of ants in the vicinity of Austin. These are, first, a yellowish white species of Lepismina, quite common in the nests of Pachycondyla, but even more abundant in the nests of *Camponotus castaneus* Latr., in the same localities. This Thysanuran was also taken in the nests of *Eciton coecum* Latr. Second, a white Collembolan, similar to, if not the same as, *Cyphodeira* (*Beckia*) *albinos* Nicol. of Europe. This insect is panmyrmecophilous, occurring in the nests of nearly all the ants of Travis County. Third, *Myrmecophila nebrascensis* Bruner, rare in the nests of Pachycondyla, but very common in the nests of *Formica fusca*, var. *neorufibarbis* Mayr. I have no doubt that this singular little cricket had strayed from the Formica to the Ponerine nests. Fourth, a small Trichopterygid beetle was sometimes found in the nests of Pachycondyla. As this same species was very common in the nests of *Camponotus castaneus*, in the same localities, I believe that it, too, may have strayed from the nests of its typical host.

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GALVESTON, June 10, 1900.